

RESTRICTED

**HANDBOOK OF INSTRUCTIONS
WITH
PARTS CATALOG**

**GENERATOR-VOLTAGE REGULATOR
(FOR AIRCRAFT)**

MODEL 3GBD1A18

Released by
**BUREAU OF AERONAUTICS
U.S. NAVY DEPARTMENT
WASHINGTON, D. C.**

**GENERAL  ELECTRIC
SCHENECTADY, N. Y.
U.S.A.**

RESTRICTED

**HANDBOOK OF INSTRUCTIONS
WITH
PARTS CATALOG**

**GENERATOR-VOLTAGE REGULATOR
(FOR AIRCRAFT)**

Model 3GBD1A18

Released by
**BUREAU OF AERONAUTICS
U.S. NAVY DEPARTMENT
WASHINGTON, D. C.**

GENERAL  ELECTRIC
**SCHENECTADY, N. Y.
U.S.A.**

Oct. 1942 (9M)

GEI-16287A
Supersedes GEI-16287

TABLE OF CONTENTS

	Page
Routine Installation and Servicing Instructions	5
Description	5
Installation and Operation	6
Inspection	10
Overhaul Instructions	11
Maintenance	11
Disassembly	13
Reassembly	13
Electrical Test	15
Parts Catalog	17

LIST OF ILLUSTRATIONS

Fig. 1. Generator-voltage regulator, Model 3GBD1A18	4
Fig. 2. Generator-voltage regulator, Model 3GBD1A18, cover removed	4
Fig. 3. Outline and mounting dimensions of regulator	6
Fig. 4. Typical external connections of Model 3GBD1A18 voltage regulators	8
Fig. 5. Setting of paralleling resistors	9
Fig. 6. Adjustment of contact bar	11
Fig. 7. Adjustment of armature air gap and pivots	11
Fig. 8. Internal connections of Model 3GBD1A18 voltage regulator	12
Fig. 9. Assembly of control unit	14
Fig. 10. Assembly of regulator unit	15
Fig. 11. Assembly of generator-voltage regulator, Model 3GBD1A18	16

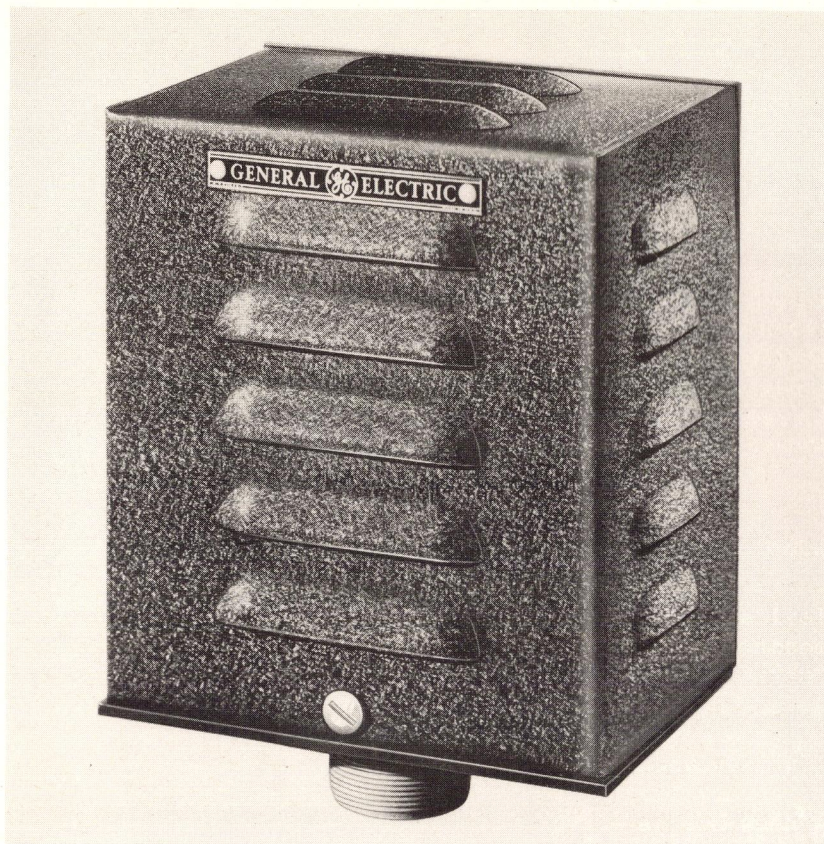


Fig. 1. Generator-voltage regulator, Model 3GBD1A18

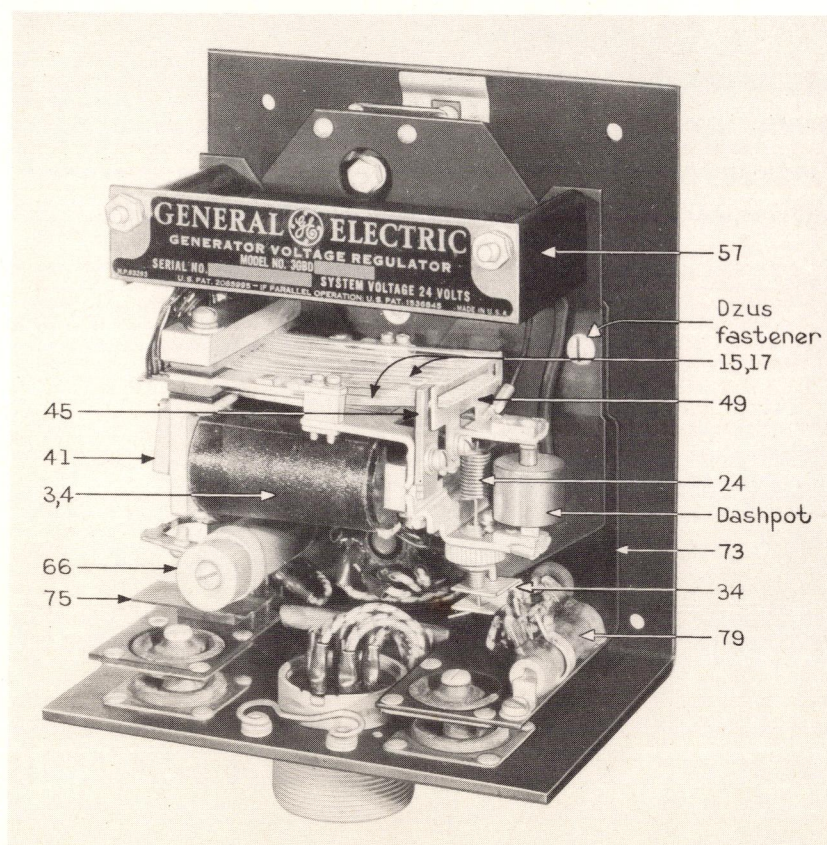


Fig. 2. Generator-voltage regulator, Model 3GBD1A18, cover removed

GENERATOR-VOLTAGE REGULATOR

Model 3GBD1A18

ROUTINE INSTALLATION AND SERVICING INSTRUCTIONS

DESCRIPTION

The following instructions cover the Model 3GBD1A18 Generator-voltage Regulator, shown in Fig. 1 and 2. The regulator is for use on aircraft and operates to maintain a constant output-voltage on 30-volt direct-current generators. The regulator is also used to equalize generator load in installations involving the use of two or more generators connected in parallel.

NOTE: At the present time, there are two variations of Model 3GBD1A18 regulator in the field, which may be distinguished from one another by the presence or absence of the terminal board (Fig. 2: Ref. 75). The original model, equipped with the terminal board, is the regulator pictured in Fig. 2. More recent models have omitted the terminal board and various wires, insulating tubings, and terminals originally associated with it. The assembly of the crash stud has also been changed and a wing-nut Dzus fastener has been substituted for the original screwdriver type Dzus fastener shown in Fig. 2. These variations are noted essentially in the external connection diagram, Fig. 4, the internal connection diagrams, Fig. 8, the assembly diagram, Fig. 11, and the Parts Catalog. It will be seen that the removal of the terminal board prohibits the use of more recent Model 3GBD1A18 regulators with double-field generators. However, the original Model 3GBD1A18 regulators, which are equipped with the terminal board, may be used with either double-field (5-amp) or single-field (8-amp) generators as described later in this handbook.

Voltage control is achieved by the use of a series of resistance steps in the regulating resistor (Fig. 2: Ref. 57) which are introduced into or shorted out from the generator-field circuit (or circuits) by a set of 24 contact fingers (15, 17) and a silver contact bar (49). These contact fingers are operated by an armature (41) in the magnetic circuit, which is energized by a pair of coils (3, 4) connected, through an adjustable resistor (66), across the voltage to be regulated. A bimetal temperature compensator (34) functions to compensate for changes in voltage due to ambient temperature variations of from -40 to +50 C.

When the current through the regulating coils (3, 4) becomes greater because of increased generator voltage, the armature (41) is pulled toward the pole pieces. This motion raises the finger-lifter (45), which in turn removes the contact fingers (15, 17), one by one from the contact bar (49). This movement is opposed by the voltage-adjusting spring (24) and is damped by the dashpot.

When the contact fingers (15, 17) are lifted from the contact bar (49), resistance is introduced into the generator-field circuits, decreasing the generator output and thus controlling the voltage. The current flows from the generator-positive terminal to the contact bar (49) and through the contact fingers (15, 17) to the regulating resistor (57). From there it goes to the field windings of the generator. When a finger lifts away from the contact bar, an element of resistance is introduced into the circuit. When all fingers are lifted from the contact bar, the maximum resistance is in the field circuit.

The regulating resistor (57) in the regulator is arranged in two 36-ohm sections. Model 3GBD1A18 regulators which are equipped with the terminal board (75) are wired so that, by changing a terminal on the terminal board (75), it is possible to use the regulator on either double-field (5-amp) or single-field (8-amp) generators without any change in external wiring. In the case of the single-field connection, the two resistance sections are connected in parallel, with a total of 18 ohms. It is also possible to obtain 72 ohms in a single circuit, by making the proper changes in the external wiring. (See Fig. 4.)

One of the coils (4, nearer the base) contains both a regulating and an equalizer winding. This latter winding serves to equalize the load carried by several generators operating in parallel. The flux of the equalizer coil, in combination with the flux of the regulating coils (operating the contact fingers (15, 17) acts to change the resistance in the generator-field circuit or circuits in such a way that load is distributed in proportion to generator ratings. The equalizer winding is connected as shown in Fig. 8. It is energized from the voltage

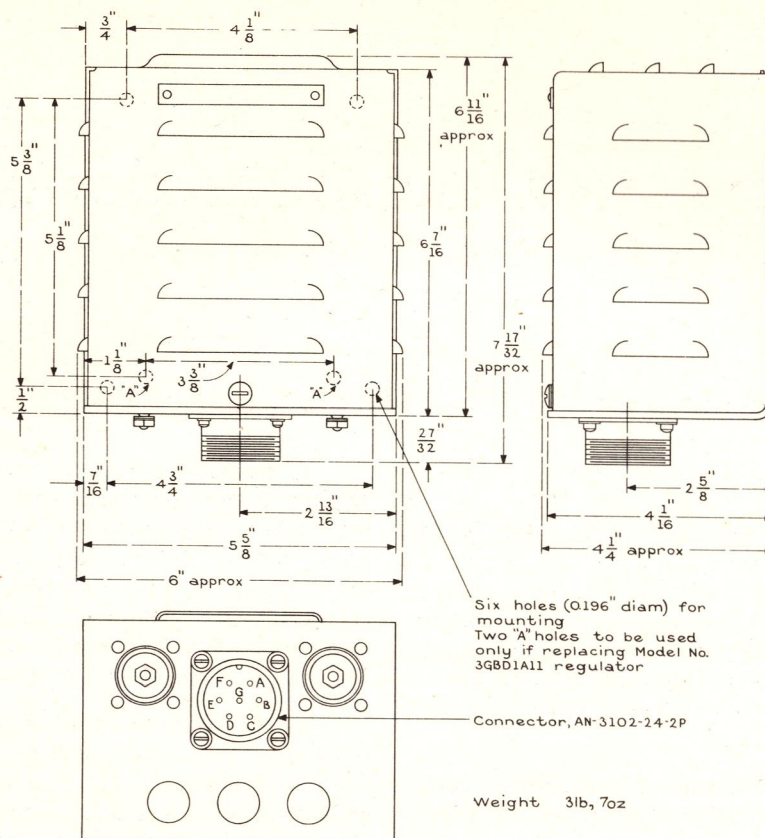


Fig. 3. Outline and mounting dimensions of regulator

drop across the adjustable paralleling resistor (79) which is connected from the negative brush of each generator to the negative bus. This drop will be proportional to the load carried by each generator if the paralleling resistors are properly adjusted. The resistors must be adjusted individually after installation of the apparatus in the plane, to take into account the differences in wiring resistances and resistances of series fields on generators of different manufacture. (See INSTALLATION AND OPERATION.)

The regulator has a detachable regulator unit. By releasing the two Dzus fasteners (Fig. 2), the regulator unit can be removed from the sub-base (73) without disturbing the remaining portion of the regulator. In a majority of cases, only this removable portion will need to be replaced. This can easily be done without removing the paralleling resistors and their connections from the circuit, avoiding the necessity of resetting the paralleling resistors when a new regulator unit is installed. This is true only if neither the airplane wiring nor the generators are changed.

INSTALLATION AND OPERATION

The regulator should be unpacked and inspected for possible damage in shipment. Shipping blocks should be removed if present. The regulator should

be installed in a place where there is sufficient ventilation. This is very important, for the regulator is likely to overheat if not properly ventilated. It is also recommended that it be installed in a place as free as possible from vibration and shock.

The regulator should be mounted in a vertical position as shown in Fig. 1 and 2, since, in this position, heat from the regulating resistor (57) will tend to flow away from the rest of the regulator, and the most effective use is made of the shock mountings. Four holes are provided for mounting. Outline and mounting dimensions are shown in Fig. 3.

After mounting, connections should be made as per the wiring diagram for the particular installation under consideration. Fig. 5 is a schematic diagram showing connections of the regulator with various types of generators. Particular attention should be given to make sure that polarities are as indicated. If the regulator is equipped with a terminal board (Fig. 2: Ref. 75), be sure that the terminal B on the terminal board is in the right position for the generator being used. In general, for single-field generators connect B to S; for double-field generators connect B to D.

The lead resistances should be as follows (see Fig. 4).

Lead (Fig. 4)	Max Res. (ohms)	Max Curr. Ea. Lead (amps)	Generator
S + P	0.4	0.4	All 28.5 volt
J + N	0.3	0.8	
D + K	0.16	0.06	
A + M	0.125	8	8-amp (single) field gen.
A + C	0.20	5	5-amp (double) field gen.
M	0.05	10	5-amp (double) field gen.
B + E + H	0.0110	140	140 amp
B + E + H	0.0056	267	267 amp
B + E + H	0.0050	300	300 amp
B + E + H	0.0037	400	400 amp
L + Q	*	*	Aux. Engine Starting

* Leads L and Q should be of comparable size to B, E, and H above. (Instantaneous starting current is considerable greater than generator rating, but lead resistance is not as critical.)

After all connections have been completed and checked, start the generator. The voltage will be regulated automatically to a value determined by the setting of the voltage-adjusting spring (24), provided the generator speed is high enough to generate this voltage but not so high as to require more resistance in the field circuit than is available in the regulator. The regulator is factory-adjusted to hold 28.5 volts but may be adjusted to any voltage between 26 and 30 volts by turning the voltage-adjusting nut (36).

Batteries should be used in conjunction with this equipment for best possible operation.

When two or more generators, with their regulators, are operating in parallel, the equalizer coils in the regulators will cause the generators to divide the load in proportion to the generator ratings, provided, however, that all regulators are adjusted to the same voltage and provided that the paralleling resistors are set properly.

SETTING OF PARALLELING RESISTORS: The paralleling resistor (79) should be set according to one of the following methods after installation of the regulators in the plane.

Method I: To be used when test equipment is available. The following equipment is required for this adjustment in order to avoid the necessity of operating the plane engines:

Qty	Item	Rating
1	Variable resistor (preferably of the carbon-pile type)	Ohms: 0.5/5.0 Amps: 10 per cent generator rated-current Max Dissipation: About 1000 watts
1	Ammeter	To read 10 per cent generator rated-current
1	Voltmeter	0/0.50 volts
1	Switch	Single-pole single-throw

Referring to Fig. 5, proceed as follows:

1. Open the control switch (or otherwise open the equalizer coil circuits) of all generators but the one whose paralleling resistor is to be adjusted.
2. Set the slider on the paralleling resistor (79) in the regulator of this first generator at approximately 3/4 of the way from the end connected to terminal F of the regulator. (This is the back end of the resistor.)
3. Connect test equipment (consisting of the variable resistor,) switch and ammeter in series across terminals BAT and GEN of the relay associated with the generator and regulator being set, as shown in Fig. 5. Also connect the voltmeter as shown.
4. Close the switch in the test circuit and by means of the test variable resistor, adjust the current to 10 per cent of generator rated current. At this point read and record the voltmeter reading.
5. Open the control switch of this generator and close the one on the next generator to be set. Connect the test current leads to the relay of this generator as shown in dashed lines in Fig. 5.
6. With a current of 10 per cent of rating of this generator, adjust the slider on the paralleling resistor (79) until the voltmeter reading is the same as the voltmeter reading recorded in step 4.
7. Repeat this procedure for all other generators. If there is an auxiliary-engine-driven generator in the installation, it is suggested that the above procedure first be applied to that generator, inasmuch as the voltage drop across its compensating field is less than that of the main-engine-driven generators. In this case, the paralleling resistor for the auxiliary generator should be set so that

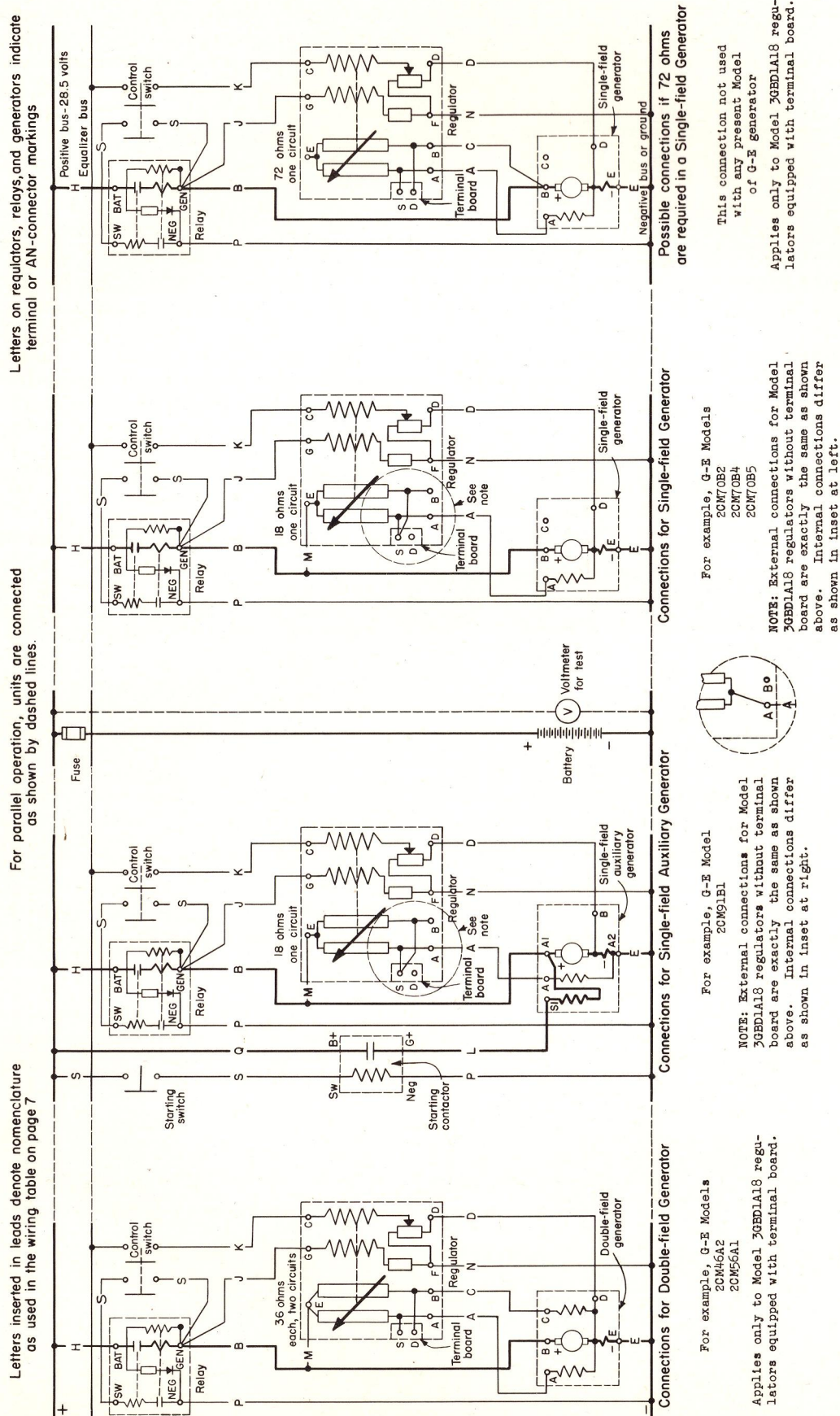


Fig. 4. Typical external connections of Model 3GBD1A18 regulators

maximum voltage is obtained (slider all the way up rather than 3/4 of the way) in order to take full advantage of the voltage drop available for paralleling.

Method II: To be used when no test equipment (except a low-scale voltmeter) is available, as when servicing the airplane in the field. The paralleling resistors (79) can be set by running the engines and loading each generator, one at a time, to a fixed percentage of full-load, this load to be obtained from various apparatus and appliances in the airplane. A low-scale voltmeter is needed for this method. The magnitude of voltage to be read is dependent upon the percentage of full load to which each generator is loaded. This voltage is usually from about 1.0 to 2.0 volts at full load. Proceed as follows:

1. Open the control switch (or otherwise open the equalizer coil circuits) of all generators but the one whose paralleling resistor is to be adjusted.
2. Set the slider on the paralleling resistor (79) in the regulator of this first generator at approximately 3/4 of the way from the end connected to terminal F of the regulator. (This is the back end of the resistor.)
3. Load the generator to any given percentage of its rating.
4. Read and record the voltage drop between the negative bus and the slider contact on the paralleling resistor.
5. Open the control switch of this generator and close the one on the next generator to be set.
6. Load this generator to the same percentage

of its rating as in step 3, noting that this load is not the same as for the first generator if the generator current ratings differ. Adjust the slider on the paralleling resistor until the voltage drop between the negative bus and the slider contact is the same as recorded in step 4.

7. Repeat this procedure for all other generators. If there is an auxiliary-engine-driven generator in the installation, it is suggested that the above procedure first be applied to that generator, inasmuch as the voltage drop across its compensating field is less than that of the main-engine-driven generators. In this case, the paralleling resistor for the auxiliary generator should be set so that maximum voltage is obtained (slider all the way up rather than 3/4 of the way) in order to take full advantage of the voltage drop available for paralleling.

When some of the generators are not running or are disconnected from the line, the bus voltage will droop with load as the result of the current flowing through the equalizer windings of the generators which are still in operation and returning through the equalizer circuits of the generators that are not in operation. The current through the equalizers of the regulators in service will be in such a direction as to cause the generators to reduce voltage. This droop in voltage can be prevented by opening the equalizer circuit of the regulators not in service.

NOTE: If after setting the paralleling resistors as described above, it is found that the generators have a tendency towards a too rapid interchange of load, the voltage drop used to energize the equalizer coils should be reduced.

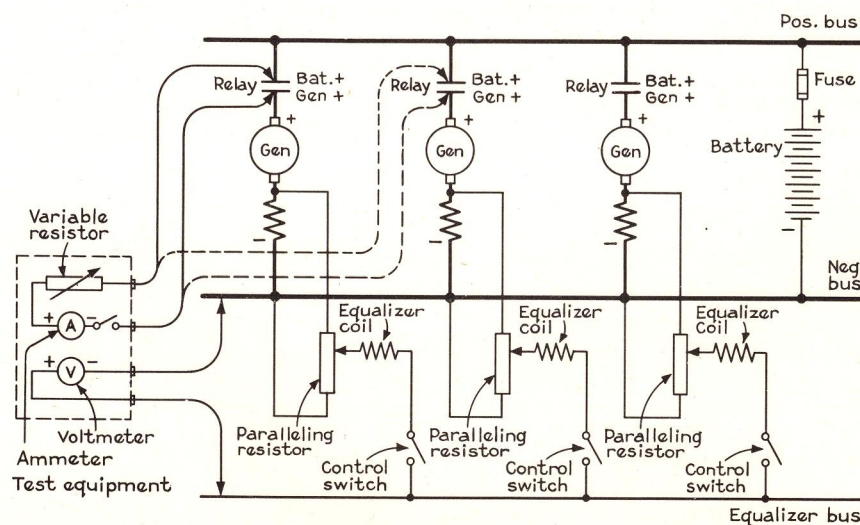


Fig. 5. Setting of paralleling resistors

INSPECTION

The regulator should be inspected at intervals of 240 and 1020 hours of actual operation as outlined below. No oil or grease should be used on any part of the regulator. No special tools are required for the maintenance of the regulator.

240 hours: Examine the contact surfaces of the silver contact bar (Fig. 2: Ref. 49). If the bar is pitted or burned, remove it from the regulator. Place it in a suitable filing fixture and dress up the contact edges, being careful to maintain constant the spacing between edges. Reassemble the bar on the regulator and adjust it to meet the requirements given in the following section. When proper adjustment can no longer be obtained after dressing up the contact bar, a new bar should be installed.

Examine the contact fingers (15, 17) for evidence of overheating or arcing. If the tips are badly burned or if the fingers have lost their temper due to overheating, replace the contact finger assembly (13).

Examine the regulating resistor (57). Watch for cracks or melted solder, which indicate overheating in the resistor. If such is the case, replace the voltage regulator and before installing a new regulator, the cause of overheating should be investigated and corrected. Overhaul the regulator in accordance with the following section. Check the regulation as explained in ELECTRICAL TEST.

1020 hours: Replace the regulator and completely overhaul in accordance with the following section.

OVERHAUL INSTRUCTIONS

MAINTENANCE

At every 1020 hours of operation or whenever the regulator fails to function correctly, the checks and adjustments outlined in the following paragraphs should be made. Reference numbers in parentheses refer to Fig. 9 and 10, and the parts catalog.

Check the resistance steps of the regulating resistor (57 or 57A) as follows. (If the regulator is equipped with a terminal board (75), be sure lead B is connected to terminal S on the terminal board when this check is being made):

Insulate the contact fingers (15, 17) from the contact bar (49) with a piece of paper, first insulating only the fingers S and S1 (see Fig. 6). Measure the resistance between terminals A and E of the AN-connector (68). This should be 0.12 ohm as shown for step one in the table below. For the second step insulate fingers S, S1, N, and N1 and check in the same manner. For each succeeding step insulate one more finger in each row until all fingers are insulated for step 12. The cumulative resistances should check with the values listed in the table. The resistance of the first eleven steps may vary ± 20 per cent provided the total resistance, step 12, checks within ± 12 per cent.

Step	Ohms	Step	Ohms
1	0.12	7	3.4
2	0.28	8	5.0
3	0.51	9	7.2
4	0.86	10	10.0
5	1.4	11	13.6
6	2.2	12	18.0 Total

If the resistance of any section of the resistor is found to be incorrect, the connections between the

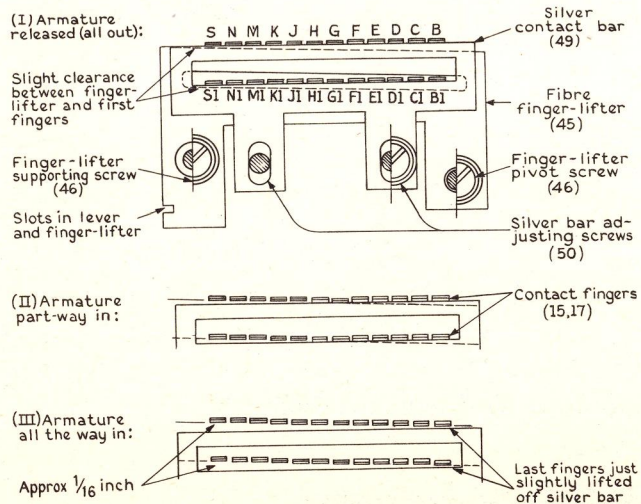


Fig. 6. Adjustment of contact bar

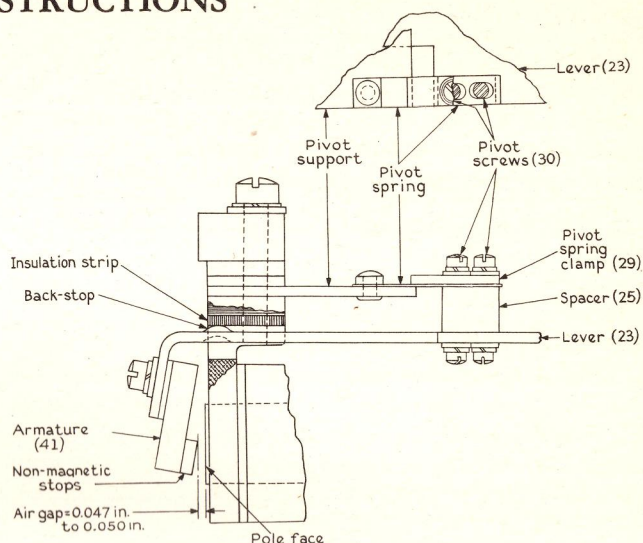


Fig. 7. Adjustment of armature air gap and pivots

contact fingers and the resistor should be examined for loose, broken, or short-circuited wires and checked against the wiring diagram (Fig. 8). If no faulty connections are found, the regulating resistor (57 or 57A) should be replaced.

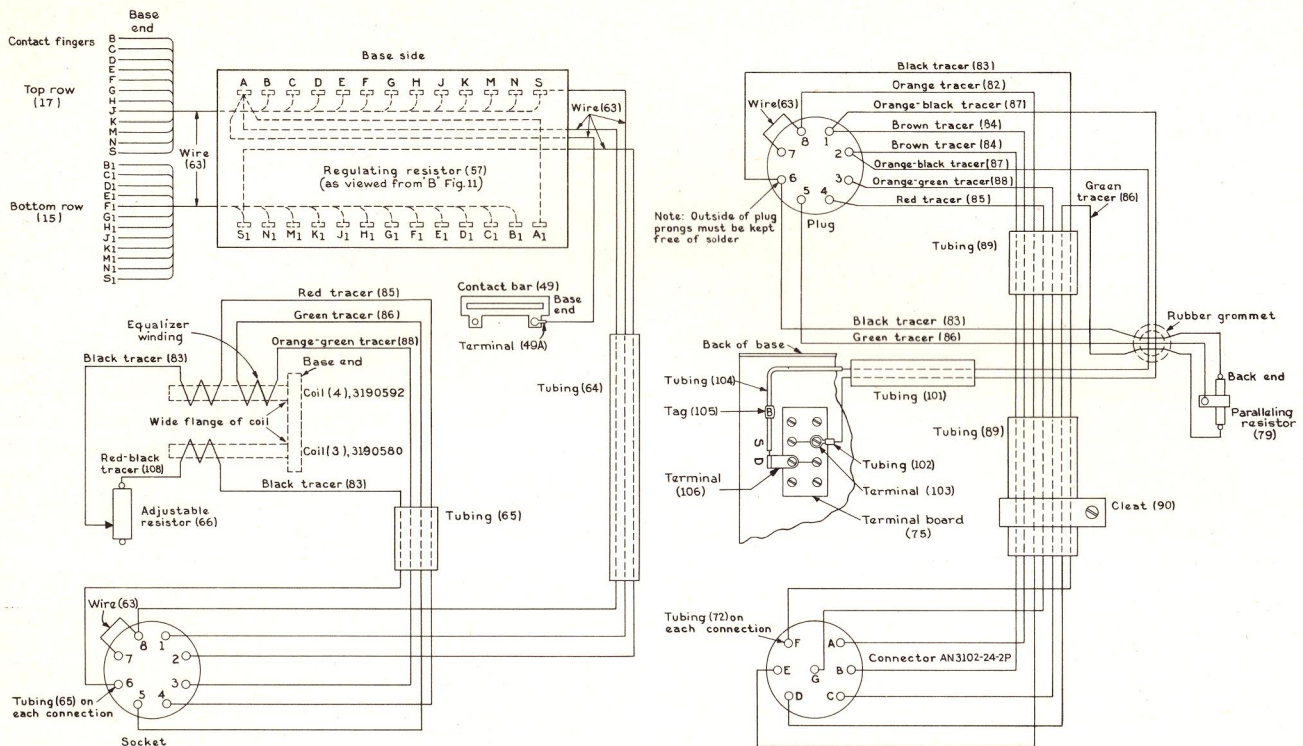
Check the resistance of the regulating coils (3,4) the adjustable resistor (66), and the paralleling resistor (79). If the resistances are not as follows the coil or resistor should be replaced.

Ref. No.	Description	Resistance (ohms)
3	Coil (3190580)	$3.71 \pm 5\%$
4	Coil (3190592) *potential winding †equalizer winding	$2.98 \pm 5\%$ $0.40 \pm 5\%$
66	Adjustable resistor	$38.00 \pm 10\%$
79	Paralleling resistor	$2.00 \pm 10\%$

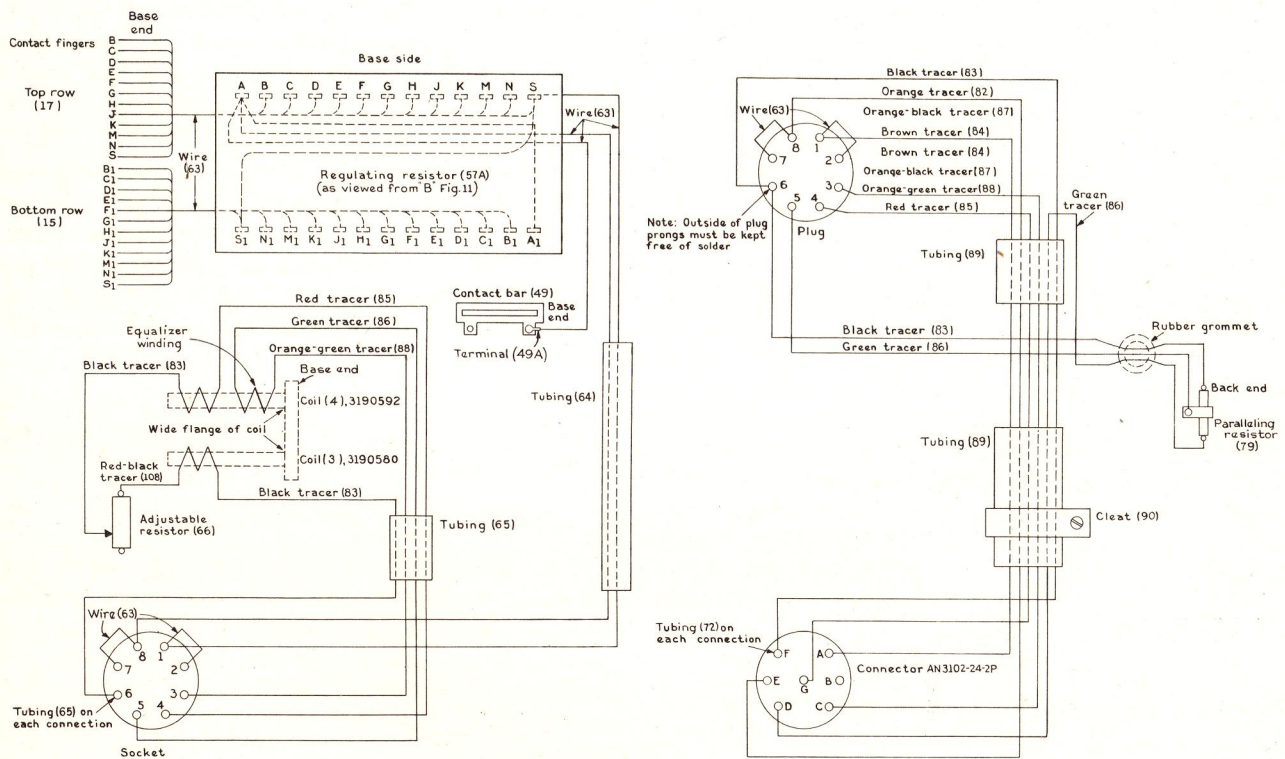
* Identified by the red-tracer wire and the black-tracer wire (Fig. 8).

† Identified by the green-tracer wire and the orange-and-green-tracer wire.

Check the air gap (see Fig. 7) between the armature (41) and the pole faces. Make sure that the backstop on the lever rests against the insulation strip above it when the gap is being checked. If the gap is not 0.047 to 0.050 inch as specified, adjustment may be made by loosening the two pivot screws (30) at each pivot, inserting a 0.047-inch-gage block in the air gap, and tightening the screws while holding the armature tight against the gage and pressing the backstop firmly against the insulation strip above it.



Connections for regulator equipped with terminal board



Connections for regulator not equipped with terminal board

Fig. 8. Internal connections of Model 3GBD1A18 voltage regulator

The lever and cylinder assembly (23) should move freely. If it does not:

1. Check the clearance between the finger-lifter (45) and the contact bar (49). If they should touch in any position of lever, the contact bar may be bent slightly away from the finger-lifter (or the lever may be bent slightly) to give the finger-lifter proper clearance.
2. Check the dashpot. See that it does not bind, either because of being too tight or because of misalignment of supports.
3. Check the pivot springs (Fig. 7). Spring clamps (29) should be straight and springs should lie flat and fairly well aligned with one another. Bent springs or clamps should be replaced.

The backstop on the lever (Fig. 7) should rest against the insulation strip above it when the lever is in free position. If it does not:

1. See that neither the finger-lifter (45) nor the lever rests on the support (9) of the contact bar before or at the end of travel.
2. Check the dashpot. It should not bottom before the end of travel. A bent lever or piston support should be replaced if it interferes with proper operation.

Check the adjustment of the silver contact bar (49). (See Fig. 6.) In correct operation, the first contact finger (lettered S or S1) should start lifting from the bar almost as soon as the armature (41) starts moving in. The rest of the fingers (N, M, K, etc.) should pick up in succession until, at the end of armature travel, the last finger B or B1 should be just slightly lifted from the contact bar (49). When the armature (41) is returned to its normal position, all the fingers should again make contact with the contact bar. If necessary, adjustments may be made by slightly loosening the screws (46) holding the finger-lifter (45) and moving the finger-lifter up or down using a screwdriver placed in the slot provided on the outer edge. Additional adjustment may be made by changing the position of the silver contact bar (49) after loosening its supporting screws (50). If some fingers and contact bar should be burned, replace the burned fingers and dress up the silver in a filing fixture, being sure to maintain the spacing between the two contact edges.

When replacing either the piston and support assembly (33) or the lever and cylinder assembly (23), it is necessary to order both assemblies together in order to assure correct fit of the piston in the cylinder. Shim (41A) should be ordered together with the lever and cylinder assembly to assure proper clearance between the finger-lifter (45) and the contact bar (49). Since none of these parts

(23, 33, 41A) should be ordered separately, they have been combined under one catalog number as "dashpot and armature shim" (22A) for convenience in spare-parts procurement and stocking.

DISASSEMBLY

The regulator is disassembled in the following manner. Reference numbers, in parentheses, refer to Fig. 9, 10, and 11, and the parts catalog. (See NOTE under DESCRIPTION.)

Remove the cover (Fig. 11: Ref. 107). Release the two Dzus fasteners and pull out the regulator unit (1). Remove sub-base assembly (73) from the shock mountings of plate (67), disconnecting necessary leads. Detach the paralleling resistor (79) and terminal board (75) (if present). Detach the connector (68) from the plate (67).

Disassemble the regulator unit (Fig. 10) by first removing the wires (63) soldered to the contact fingers. Dismount the regulating resistor (57) and the nameplate (58). Remove the base (53) from the control unit (2), removing necessary leads. Remove resistor (66).

Disassemble the control unit (Fig. 9) detaching the contact bar (49) and the finger-lifter (45). Remove the armature (41) and shim (41A) from the lever and cylinder assembly (23). Straighten the bent end of spring (24) which extends beyond the stud and temperature compensator (34). Detach the piston and support (33), from the cores and support (5). Remove the stud and temperature compensator (34) and adjusting nut (36) from the piston support.

Detach the cores and support (5) from the contact fingers and support (13). Remove the pivot screws (30), detaching the spring clamp (29) and the lever and cylinder assembly (23) from the contact fingers and support (13). If necessary, the contact fingers and support (13) can be disassembled by removing the two clamping screws (19).

Remove the coils (3, 4) from the cores (6). Detach contact-bar support (9) and remove core support (7) from the cores (6).

REASSEMBLY

Whenever the regulator has been completely disassembled, reassembly is made in the following manner. Reference numbers in parentheses refer to Fig. 9, 10, and 11, and the parts catalog. (See NOTE under DESCRIPTION).

In assembling the regulator, the wires to the regulating resistor (57) and adjustable resistor (66) are brazed to the taps with G-E Spec. B20A6 solder (Navy Equiv. 47S13 (INT), GR. III). On all other soldered connections, G-E Spec. B20D3 solder (Navy Equiv. 46S20 (INT), GR. B) is used. Properties of these solder materials are as follows:

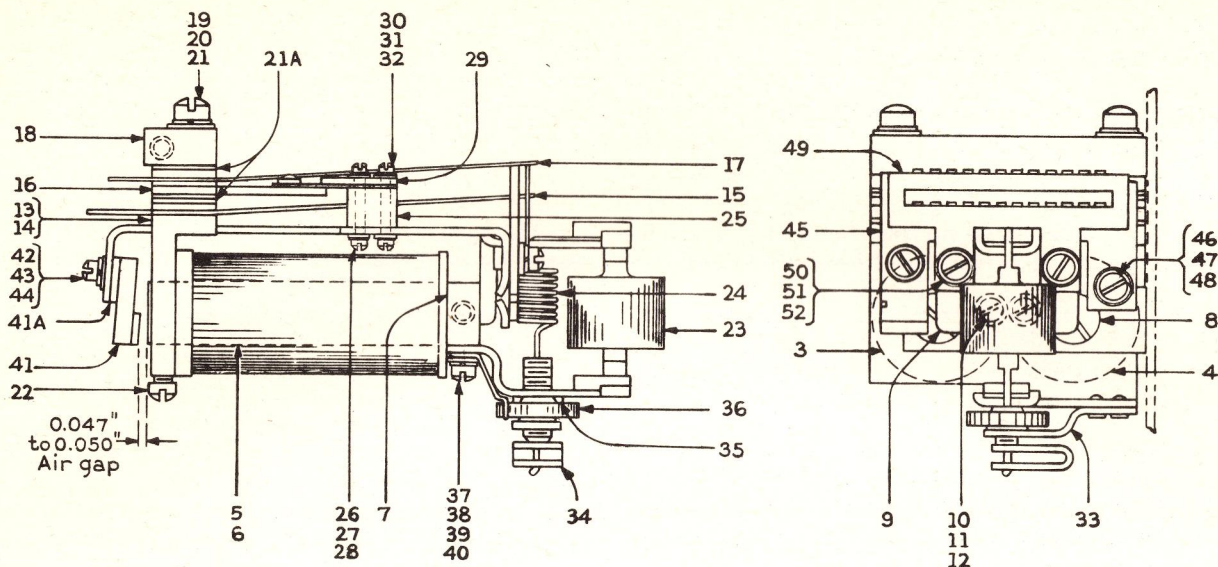


Fig. 9, Ref. 2. Assembly of control unit

Solder G-E Spec.	Composition	Melting Temp	Brazing Temp
B20A6	15% Ag 80% Cu 5% P	640 C	700 C
B20D3	60% Pb 40% Sn	181 C	- - -

Control Unit: Referring to Fig. 9, assemble the control unit (2). Fasten the cores (6) to the core support (7) with screws (8). Press the coils (3, 4) on the cores as far as they will go. The F-3190592 coil (4), having both a potential and an equalizer winding, should be placed on the core nearer the tapped side of the core support (7). The thick flange end of both coils should be toward the support-end of the cores. Add the contact-bar support (9), fastening in place with No. 1276 Glyptal cement and screws (10), washers (11), and lock washers (12).

Assemble the top row (17) and bottom row (15) of contact fingers with springs and support (16) and insulation strips (21A) between, adding bracket (14), support (18), screws (19), washers (20), and lock washers (21). Attach the lever and cylinder assembly (23) to the contact finger and support assembly (13), by placing the spring clamps (29) in position and fastening with pivot screws (30), washers (31), and lock washers (32), tightening the screws only slightly.

Assemble the cores and support assembly (5), with the coils in place, to the contact fingers and support assembly (13), by pushing the core ends through the holes in bracket (14) so that they protrude approximately 1/64 inch. Fasten with the

screws (22) and tighten them securely, for the alignment of the entire regulating unit depends upon their firmness. Assemble the stud and temperature compensator (34), and adjusting nut (36) to the piston support. Fasten this piston and support assembly (33) to the cores and support assembly (5), by inserting the piston in the cylinder and the spring (24) through the stud and temperature compensator (34), adding spring (37), plate (38), and tightening screws (39) with lock washers (40). Stretch the spring slightly and bend over the end (extending beyond the temperature compensator) at slightly less than a right angle.

Fasten the armature (41) to the lever end of the lever and cylinder assembly (23), inserting the shim (41A) between and adding screws (42), washers (43), and lock washers (44). Attach the finger-lifter (45) using screws (46), washers (47), and lock washers (48). Add the contact bar (49), with terminal (49A) under the right-hand supporting screw of the contact bar, using screws (50), washers (51), and lock washers (52). Line up the slot in the finger-lifter with the slot in the lever and tighten the screws supporting the finger-lifter. Leave the contact-bar supporting screws loose.

Referring to Fig. 10, add the base (53) to the assembled control unit, fastening with screws (54), washers (55), and lock washers (56).

Referring to Fig. 7, adjust the air gap between the armature and the pole pieces. Loosen the top pivot screws and place a 0.047-inch gage block in the air gap. With the armature held firmly against the gage and the backstop pressed firmly against the insulation strip above it, tighten the pivot screws. The pivot springs should be aligned with

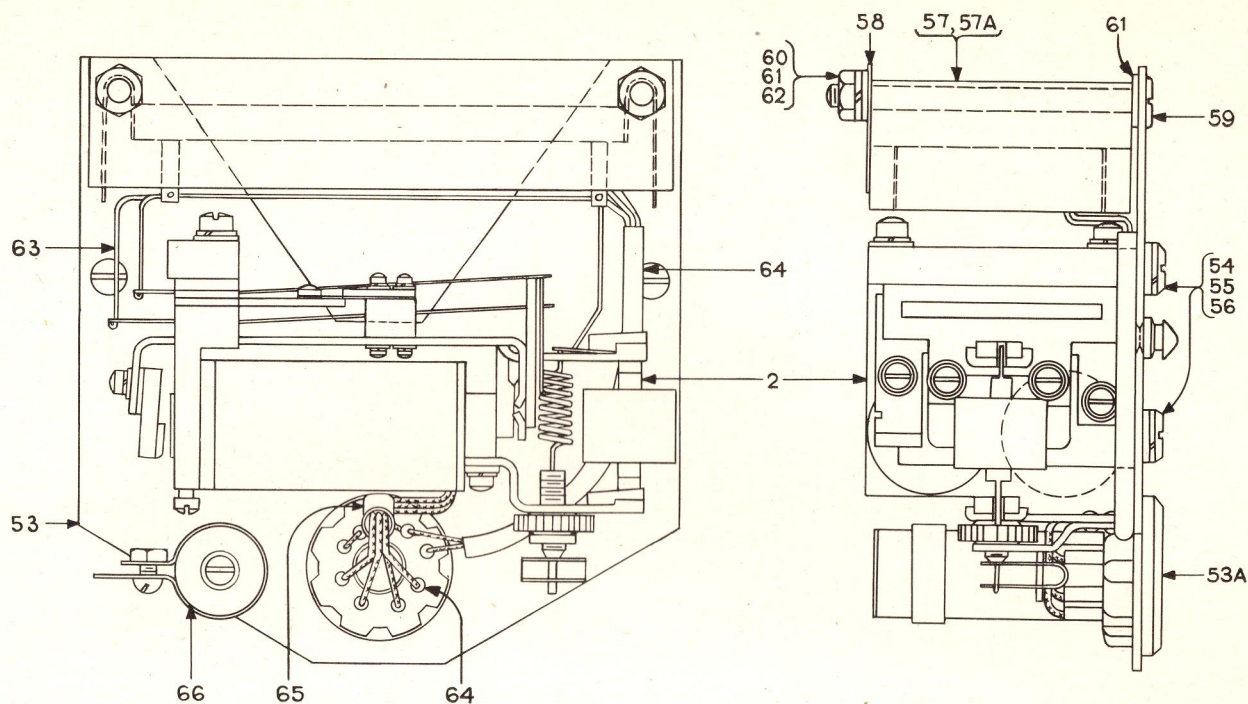


Fig. 10, Ref. 1. Assembly of regulator unit

one another. Spring clamps (29) should be fastened straight and square when the pivot screws are tightened.

Referring to Fig. 6, adjust the contact bar. When the armature is released (I), all contact fingers should touch the contact bar. The first finger (lettered S or S1 in Fig. 6 and farthest from the base) should begin lifting almost as soon as the armature starts moving in. The rest of the fingers (N, M, K, etc.) should pick up in succession (II), until the end of armature travel (III), when the last finger (B or B1) should be just slightly lifted from the contact bar. The corresponding fingers in both top and bottom rows should move approximately in unison. Note that a terminal (49A) is provided under the right-hand screw supporting the contact bar. This terminal should be in a position which does not interfere with the proper operation of the contact fingers.

Referring to Fig. 10, add the regulating resistor (57) to the assembled control unit, adding the nameplate (58), and fastening with screws (59), nuts (60), washers (61), and lock washers (62). Solder the wires (63) from the regulating resistor to the proper contact fingers as shown in Fig. 8. Add the adjustable resistor (66) by means of the screw provided. Wire as shown in Fig. 8.

Referring to Fig. 11, fasten the AN connector (68) to plate (67) by means of screws (69), washers (70), and lock washers (71). Add the paralleling resistor (79), to sub-base (73), fastening with screws (80) and lock washers (81). If the regulator was originally equipped with a terminal board, add this

terminal board (75) and plate (74) to sub-base (73), fastening with screws (76), washers (77), and lock washers (78). Wire the plug of sub-base (73) to the AN connector as shown in Fig. 8. Fasten the wires with cleat (90), screw (91), and lock washer (92). Add the sub-base (73) to the lower and top shock mountings of plate assembly (67), fastening with screws (93), nuts (94), washers (95) and lock washers (96). On Model 3GBD1A18 regulators which are equipped with terminal board (75), (see NOTE under DESCRIPTION), fasten washer (97) to the crash stud on the sub-base (73) by means of screw (98), washer (99) and lock washer (100). Wire terminal board (75) and the paralleling resistor (79) as shown in Fig. 8. On Model 3GBD1A18 regulators which are not equipped with the terminal board (75), use washer (97), screw (98A), spacer (100B), washer (99) and nut (100A) as shown in the sketch accompanying Fig. 11.

Plug the regulator unit into the sub-base, fastening with the two Dzus fasteners. Check the wiring as shown in Fig. 8. The regulator should now be inspected for mechanical details as in MAINTENANCE and tested and adjusted according to ELECTRICAL TEST. Replace the cover (107).

ELECTRICAL TEST

Connect the regulator as shown in Fig. 4.

With the generator running at a speed below that necessary to generate 28.5 volts (or low enough so that the regulator has not yet started to regulate)

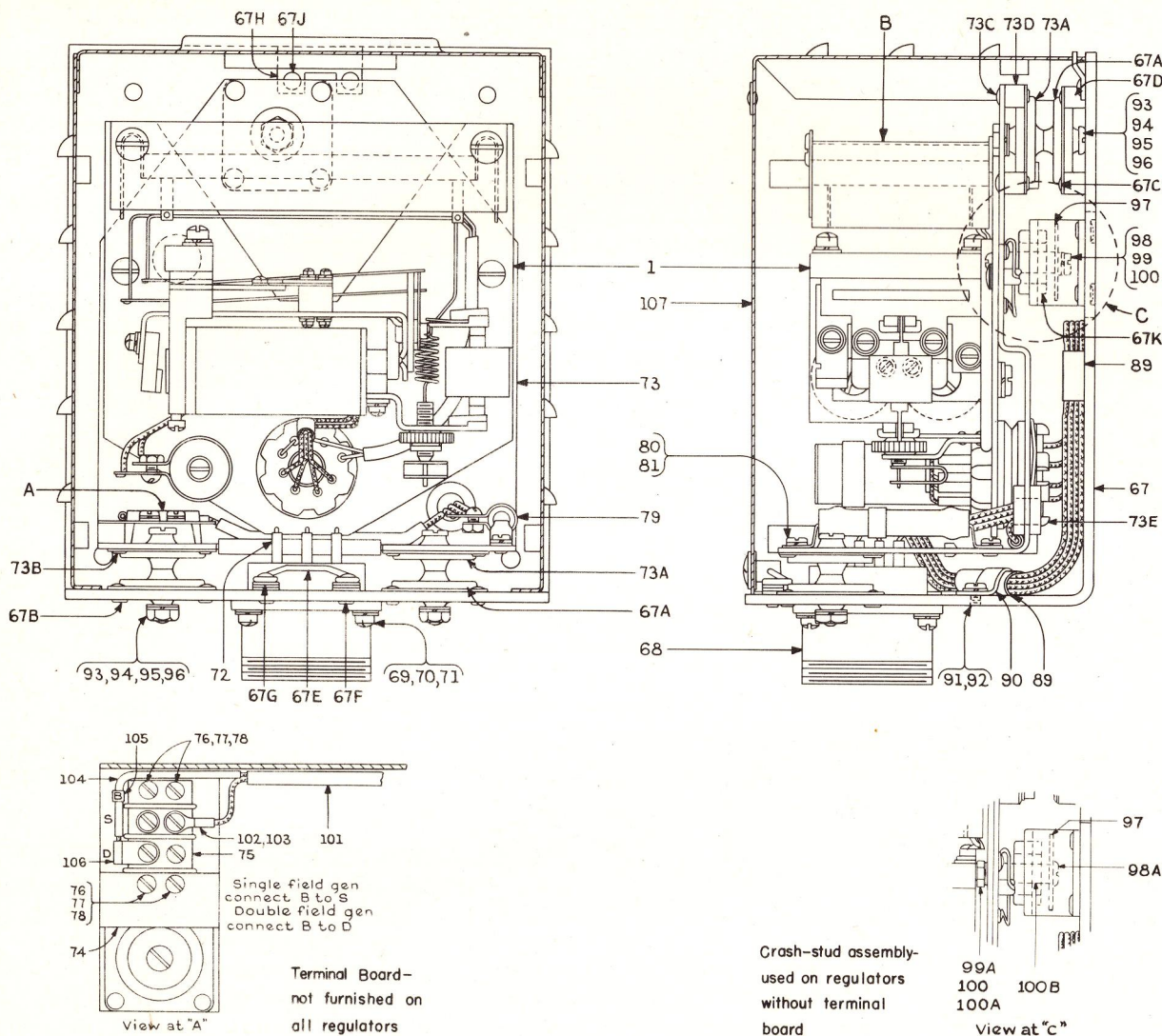


Fig. 11. Assembly of generator-voltage regulator, Model 3GBD1A18

check the voltage drop between regulator terminals A and E and between B and E, which should be approximately zero. If not so, all contact fingers (15, 17) may not be making electrical contact to the silver contact bar (49) when the armature (41) is all the way out. This can be corrected by proper adjustment of the finger-lifter (45). (Note: If the situation is such that the speed of the generator cannot be lowered enough to obtain this condition, the same effect may be obtained by loading the generator.)

Bring the generator to a regulating speed and adjust the voltage-adjusting spring until the regulated voltage is approximately 28.5 volts, as measured by a voltmeter (see Fig. 4: V) connected across the bus. Make sure that voltage regulator is regulating while this adjustment is being made.

Set the speed to rated base speed and apply full load. Note the voltage (V) at this point.

Increase the generator speed to rated top speed.

At no-load note the regulated voltage. Repeat these last two operations as a check.

If the regulated voltage increases with the speed of the generator, decrease the adjustable resistance (66) in the regulator potential coil circuit (by moving the adjustable terminal nearer the fixed one). Conversely, if the regulated voltage decreases with increasing speed, increase the adjustable resistance (66). Adjust the resistance until the regulated voltage is approximately the same at both minimum speed, full-load, and maximum speed, no-load. When finally set, the resistance should not be under 30 ohms. For each setting of the adjustable resistor, it is necessary to readjust the spiral spring to give 28.5 volts.

The regulated voltage should be checked at several points in the range of speed and load to be covered, to determine if voltage remains constant at 28.5 volts ($\pm 2\frac{1}{1\%}$). If it is impossible to adjust satisfactorily by the means just mentioned, check the points listed in MAINTENANCE.

PARTS CATALOG

GENERATOR-VOLTAGE REGULATOR, MODEL 3GBD1A18

When ordering renewal parts, give quantity, catalog number, and description of each item required.

Fig. No.	Ref. No.	Cat.No.	No. Req.	Description	†Spares
10,11	1	6994451G1	1	Regulator unit	∅ 5
9,10	2	6994400G4	1	Control unit	
2,8,9	3	3190580	1	Coil	10
2,8,9	4	3190592	1	Coil, two-winding	10
9	5	6970872G1	1	Cores and support	
9	6	6970876	2	Core	
9	7	6970877	1	Support, core	
9	8	*AN505-10-8	2	Screw	
9	9	6970868	1	Support, contact-bar	10
9	10	*AC500-4-6	2	Screw	20
9	11	*AN960C4	2	Washer	20
9	12	*AN935-4	2	Washer, lock	20
9	13	6970890G1	1	Contact fingers and support	
9	14	6970878	1	Bracket	
2,8,9	15	8072099G2	1	Contact fingers, bottom row	25
9	16	6970882G1	1	Springs and support	10
2,6,9	17	8072099G1	1	Contact fingers, top row	25
9	18	6970879	1	Support	
9	19	*AC500-8-16	2	Screw	30
9	20	*AN960C8	2	Washer	30
9	21	*AN935-8	2	Washer, lock	30
9	21A	6970859P4	3	Strip, insulation	
9	22	*AC500-6-5	2	Screw	
--	22A	89X73	1	†Dashpot and armature shim (includes Ref. 23, 33, 41A)	30
9	23	6970891G1	1	‡Lever and cylinder	
2,9	24	2416264	1	Spring, voltage-adjusting	
9	25	8072011	2	Spacer	
9	26	*AC500-2-3	4	Screw	
9	27	229X1	4	Washer (for No. 2 screw steel, cd. pl.)	
9	28	*AN935-2	4	Washer, lock	
9	29	6970875	2	Clamp, spring	10
9	30	*AC500-2-3	4	Screw, pivot	20
9	31	229X1	4	Washer (for No. 2 screw steel, cd. pl.)	20
9	32	*AN935-2	4	Washer, lock	20
9	33	6970885G1	1	‡Piston and support	
9	34	8072060G1	1	Stud and temperature compensator	
9	36	8076101	1	Nut, adjusting	
9	37	8079732	1	Spring	10
9	38	6970888	1	Plate	5

† Recommended for one average overhaul of each 100 units in service

∅ For field maintenance between major overhauls, it is recommended that 25 spare regulator units (Ref. 1) be stocked

* U. S. Army and Navy or Air Corps standards number

† Ref. 22A does not fit into the break-down identification system but has been assigned a catalog number for spare-parts procurement and stocking purposes only

‡ Ref. 23, 33, 41A must not be ordered separately, but must be ordered together as Ref. 22A and used only as a complete subassembly in replacement

Fig. No.	Ref. No.	Cat.No.	No. Req.	Description	†Spares
9	39	*AC500-6-5	2	Screw	10
9	40	*AN935-6	2	Washer, lock	10
2,9	41	6970874G1	1	Armature	
9	41A	8061749	1	‡Shim, armature	
9	42	*AC500-4-5	2	Screw	20
9	43	*AN960C4	2	Washer	20
9	44	*AN935-4	2	Washer, lock	20
2,9	45	6970860	1	Finger-lifter	25
9	46	*AC500-6-5	2	Screw	25
9	47	*AN960C6	2	Washer	25
9	48	*AN935-6	2	Washer, lock	25
2,8,9	49	6970881	1	Contact bar	25
8	49A	240X91	1	Terminal, contact-bar (Thomas and Betts Co., Cat.A33, Bull.5881)	
9	50	*AC500-6-5	2	Screw	25
9	51	*AN960C6	2	Washer	25
9	52	*AN935-6	2	Washer, lock	25
10	53	8090011G1	1	Base	
10	53A	89X540	1	Socket (includes retaining ring) (American Phenolic Corp., Type S-8)	10
10	54	241X56	2	Screw (10-24, 3/8 in. flat-round h., brass, cd. pl.)	20
10	55	*AN960C10	2	Washer	20
10	56	*AN935-10	2	Washer, lock	20
2,8,10	57	8240338G1	1	#Resistor, regulating (includes leads)	15
2,8,10	57A	8240338G2	1	ΔResistor, regulating (includes leads)	15
10	58	-----	1	Nameplate (NP-94493)	
10	59	244X22	2	Screw (10-24, 2 1/2 in. flat-round h., brass, cd. pl.)	15
10	60	*AN340-10	2	Nut	20
10	61	*AN960C10	4	Washer	20
10	62	*AN935-10	2	Washer, lock	20
8,10	63	-----	§	Wire (Deltabeston, No. 22 AWG, round, Type A finish)	
8,10	64	7877239P6	§	Tubing, insulating	3 ft
8,10	65	7877239P4	§	Tubing, insulating	3 ft
2,8,10	66	240X38	1	Resistor, adjustable (Ward Leonard Co., Spec. K-40979)	10
11	67	8090000G1	1	Plate assembly	
11	67A	89X536	3	Mounting, shock (Lord Mfg. Co., Series 100, Cat.100P1)	30
11	67B	7876696P35	8	Rivet	100
11	67C	89X537	4	Rivet (Tubular Rivet and Stud Co., Cat.1351, 3/8 in. long)	100
11	67D	8068588P1	4	Spacer	40
11	67E	89X538	1	Spring, for Dzus fastener (Dzus Fastener Co., Cat.SB4-2)	5
11	67F	7876696P39	2	Rivet	15
11	67G	*AN960C6	6	Washer	50
11	67H	8078587	1	Clamp, cover	5
11	67J	7876696P22	2	Rivet	15
11	67K	89X541	1	Grommet (Goshen Rubber Co., Cat.1098)	10
8,11	68	*AN3102-24-2P	1	Connector	10
11	69	*AN500-6-5	4	Screw	35
11	70	*AN960C6	4	Washer	35
11	71	*AN935-6	4	Washer, lock	35
8,11	72	7877239P6	§	Tubing, insulating	

† Recommended for one average overhaul of each 100 units in service.

* U. S. Army and Navy or Air Corps standards number.

‡ Ref. 23, 33, 41A must not be ordered separately, but must be ordered together as Ref. 22A and used only as a complete subassembly in replacement.

Used only on Model 3GBD1A18 regulators equipped with terminal board (see NOTE under DESCRIPTION).

Δ Used only on Model 3GBD1A18 regulators not equipped with terminal board.

§ Specify length when ordering.

Fig. No.	Ref. No.	Cat.No.	No. Req.	Description	†Spares
11	73	8090001G1	1	Sub-base assembly	
11	73A	89X536	3	Mounting, shock (Lord Mfg. Co., Series 100, Cat.100P1)	30
11	73B	7876696P33	8	Rivet	100
11	73C	89X537	4	Rivet (Tubular Rivet and Stud Co., Cat.1351, 3/8 in. long)	100
11	73D	8068588P1	4	Spacer	40
11	73E	89X539	1	Plug (includes retaining ring) (American Phenolic Corp., Type CP-8)	10
11	74	8090001P18	1	#Plate	
2,11	75	245X63	1	#Terminal board (Howard Jones, Cat.2-140)	
11	76	245X64	4	#Screw (4-40, 7/16 in. flat-round h., brass, cd. pl.)	
11	77	*AN960C4	4	#Washer	
11	78	*AN935-4	4	#Washer, lock	
2,11	79	244X23	1	Resistor, paralleling (Ohmite Mfg. Co., Cat.1002 NOTCA, with No. 5 mounting brackets, 2 ohms, 10 watts)	10
11	80	244X24	2	Screw (4-40, 3/16 in. flat-round h., brass, cd. pl.)	20
11	81	*AN935-4	2	Washer, lock	20
8	82	7875044P1	§	Wire, orange tracer	
8	83	7875044P2	§	Wire, black tracer	
8	84	7875044P3	§	Wire, brown tracer	
8	85	7875044P4	§	Wire, red tracer	
8	86	7875044P5	§	Wire, green tracer	
8	87	7875044P7	§	#Wire, orange-and-black tracer	
8	88	7875044P10	§	Wire, orange-and-green tracer	
8,11	89	7877239P8	§	Tubing, insulating	
8,11	90	7878484	1	Cleat	
11	91	244X21	1	Screw (8-32, 1/4 in. flat-round h., brass, cd. pl.)	
11	92	*AN935-8	1	Washer, lock	
11	93	89X274	3	Screw (8-32, 1 1/8 in., flat-round h., brass, cd. pl.)	30
11	94	*AN340-8	3	Nut	30
11	95	*AN960C8	3	Washer	30
11	96	*AN935-8	3	Washer, lock	30
11	97	8072048	1	Washer	10
11	98	229X3	1	#Screw (6-32, 3/8 in. flat-round h., brass, cd. pl.)	
11	98A	89X273	1	ΔScrew (6-32, 1 in., flat-round h., brass, cd. pl.)	20
11	99	*AN960C6	1	Washer	40
11	100	*AN935-6	1	Washer, lock	40
11	100A	*AN340-6	1	Nut	40
11	100B	8278966	1	ΔSpacer	30
11	101	7877239P6	§	#Tubing, insulating	
8,11	102	7877239P6	§	#Tubing, insulating	
8,11	103	240X91	1	#Terminal (Thomas and Betts Co., Cat.A33, Bull.5881)	
8,11	104	7877239P6	§	#Tubing, insulating	
8,11	105	2490486	1	#Tag	
8,11	106	1457401	1	#Terminal	
11	107	6994450G1	1	Cover	5
8	108	7875044P8	§	Wire, red-and-black tracer	

† Recommended for one average overhaul of each 100 units in service.

Used only on Model 3GBD1A18 regulators equipped with terminal board (see NOTE under DESCRIPTION).

* U. S. Army and Navy or Air Corps standards number.

Δ Used only on Model 3GBD1A18 regulators not equipped with terminal board.

§ Specify length when ordering.



